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Sustainability approaches for incarceration architecture

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Abstract

Incarceration architecture by definition negates many aspects of sustainability. Natural and humane values embedded in the penal system can be in many ways ambiguous. Throughout history, it was mainly the role of sociologists to advance theories and applications of incarceration architecture. Sustainability in this type of architecture however tends to rely heavily on technical solutions [1,2]. There are many different definitions for sustainable architecture [3]. Recent publications claim that the root of sustainable architecture goes back to Ruskin and Morris. This paper argues that the sustainable features of natural and human values on the one hand and the technical issues on the other are inseparable in this type of buildings.

Historical review of prison buildings reflects the emergence of new kinds of architecture associated with reform [4]. This paper critically evaluates the design theories of prison buildings. A historical review of prison design is carried out in order to verify the sustainable factors that affected the development of prison design. The review traces sustainable issues in the development of prison buildings. The argument in this paper stems from the theory of space as an aspect of social life [5].

The paper stresses the need to apply social factors as well as technical aspects of energy conservation to achieve sustainable architecture for prison buildings. © 2002 Elsevier Science Ltd. All rights reserved.

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1. Introduction

Thirty years after the recognition of the need for "sustainable development" there is still no single, widely accepted definition. In the 1970s, the term basically referred to maintaining natural resources [6,7]. In the early 1980s sustainable development aimed to achieve lasting satisfaction of human needs and improvement of the quality of human life on the one hand [8] and maintenance of essential ecological processes and life support systems on the other [9]. In the late 1980s, the approaches to sustainability emphasised social and economic aspects, which requires elimination of poverty and deprivation as well as the conservation and enhancement of the resources base. This was followed by the most common definition of sustainable development by the World Commission on Environment and Development (1987): *The ability of humanity to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs*. Following the Earth Summit in the United Nations Conference on Environment and Development (UNCED) in Rio in 1992 "sustainable development" have become internationally accepted keywords for a political discourse committed to life, the conservation of natural resources and a sense of obligation to future generations. Sustainable development definitions have been broadened to include the ability of a society, ecosystem, or other ongoing system to continue functioning into the indefinite future, without being forced into decline through exhaustion or overloading of the key resources on which that system depends [10].

Despite the wide acceptance of UNCED's definition, "sustainable development" remains controversial because of the cultural differences and north–south divide [11,12].

Saunier [12] identified four different movements of sustainable development: human development, nature conservation, natural resources management, and environmental protection. There are, however, several pending issues with relation to interests of different human groups. This includes the viewing of sustainable development as a process of reconciliation both of human groups separated from one another by different and conflicting demands they make on their shared surroundings.

The urban scene with its complex matrix of buildings, activities, services, and transportation consumes 75% of the world's energy resources and produces the vast bulk of its pollution and climate-changing gases. Decisions made by architects are crucial to the achievement of a sustainable future [13]. Despite the importance of architecture to the overall success of sustainable development, there is still no agreement on a definition that is applicable to architecture. There is a widespread belief among architects that the UNCED definition, for example, does not specify the ethical roles of humans for their everlasting existence on the planet [14]. The term "sustainable architecture", used to describe the movement associated with environmentally conscious architectural design, has created ambivalence and confusion [15].

Emphasis, therefore, has been on technical issues such as reducing energy consumption in the construction and maintenance of buildings. Very little attention is paid to the social and economic aspects.

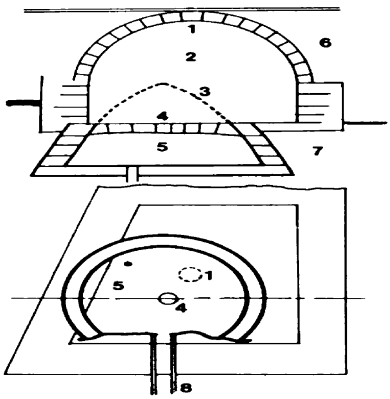
The disarray of sustainable development approaches in architecture is evident. The attempts to include ethical dimensions as well as technical dimensions are seen as contradicting to the profession of architecture itself [16]. This is despite the fact that such values are accepted by human groups with conflicting demands on their shared surroundings. When human groups do not even have a shared context, conciliation for sustainable development became even more difficult. This is the case in incarceration architecture, where issues related to human comfort became debatable in itself.

This paper investigates the conflict between the penal system in society and the essence of sustainable development. In the following section a historical review of prison design is carried out in order to trace the environmental factors that affected the development of prison design. The third section explains the technical variables that affect energy conservation, an important goal of sustainable development, in prison buildings. Emphasis is put on the impact of different façade configurations.

2. Historical review of prison building design

Reviewing the history of prison architecture will be impossible without studying the changing penal philosophy over the centuries. This section reviews the development of penal systems in order to identify the philosophical and social problems that affected the evolution of prison buildings.

Before the late 18th century, prisons scarcely had any punitive role. They were places for confinement and detention for those awaiting trial or corporal punishment and for containing personal and political enemies in the early medieval Europe. As a result of the insignificant role of imprisonment in the penal system there was no, or little, effort made to design or to build prisons. The literature illustrated that the conditions and the characteristics of such spaces were far from accommodating any elements of comfort or basic human needs [17–19]. To examine the architectural and space configurations of the prison building in its early stages the Tullianum, later called the Mamertine, in Rome can be taken as an example. Fig. 1 illustrates a reconstruction of the prison by Ancus Martius in 640 BC [20]. The prison was described as neglected, dark, overcrowded, and stench; qualities which characterised the whole concept of the prison buildings in that era.



1. Opening to vault 2. Upper prison
3. Original dome 4. Opening into tullianum
5. Lower prison 6. Earth
7. Tufa rock 8. Drain

Fig. 1. The Mamertine prison.

During the 12th and 13th centuries, coercive imprisonment of debtors in the fleet or in the tower became more common [20]. The political offenders in Europe were held in the royal prisons, a new concept which emerged in the 12th century. Many city gates were used as prisons; some of them were modified to provide the necessary accommodation [4]. Fig. 2 shows the most famous royal prison, the Bastille in Paris, which was originally a gate. It reflected the characteristics of prisons in the 16th century: "uninviting and cavern-like with frightful inscription to inspire darkness, threatening, ruins and terror" [20]. The effective measurements for a good prison at

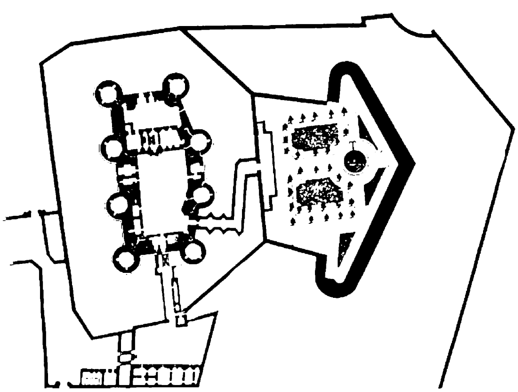


Fig. 2. Plan of the Bastille.

that time meant two things only: maximum security and brutal treatment. It was believed that the walls around the edges of towns marked the boundary between human, artificial creation and the natural world of the gods. Thus, placing offenders in the city walls and gates was the way to protect the society from foreign elements and the impurity of the offenders [21].

The mid-16th century marked the emergence of "The House of Correction" or "The Workhouse" in England as a solution for increasing unemployment and vagrancy. The use of those institutions became very widespread in Europe. Germany and Holland led the way in fully developing the model of the prison workhouse in the 17th century [22]. The improved version of the houses of correction in Holland, the Rasp house in Amsterdam 1595 (Fig. 3), had an important influence on prison development [20]. The Dutch also provided the first sign of segregation between men and women prisons when they built the first women prison in Amsterdam in 1593.

The large-scale period of prison buildings and imprisonment started in Europe in the 17th century. However, the chaos in the prisons' condition, function, and system did not witness any progress till the beginning of the 18th century when the first cellular prison in the world was erected. St Michael's prison was built in Rome in 1704 (Fig. 4) [23,24]. Architecture was for the first time utilised to embrace a reform system. The separation concept was introduced in order to allow offenders to reflect on their misdeeds in solitude. The three tiers of the ten cells in each side of the large well-lit hall containing the altar, which was designed to be visible from all the cells, carried out this task. All the cells had two windows one looking to the outside, and the other looking into the court, which was completely open from floor to roof and used as a workroom. Carlo Fontano's idea of the court was copied in most of the succeeding prisons until the 20th century [21]. With his design, he satisfied the important function of prison, that is the ease of supervision. St Michael's prison is considered the first prison designed with a definite and recognisable architectural expression of its own. With its simplicity and functionality it influenced prison archi-

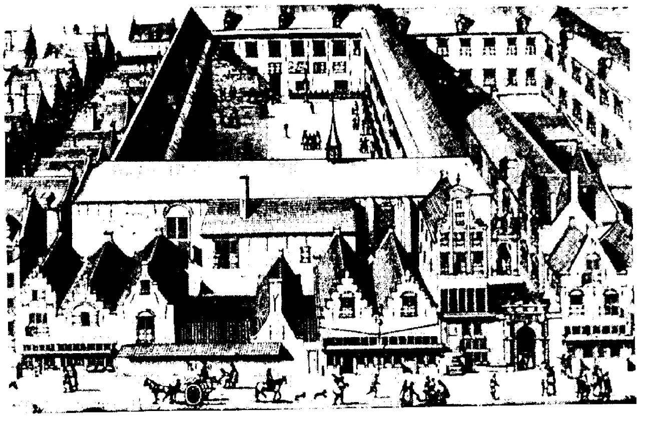


Fig. 3. RASP house in Amsterdam.

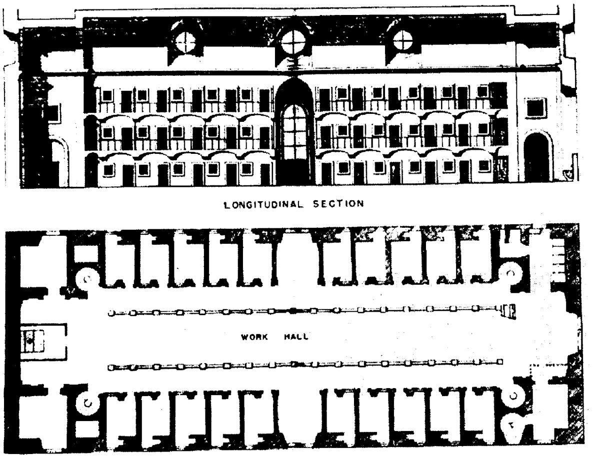


Fig. 4. Plan and section of St Michael's prison, Rome.

tecture for the next 200 years and led to the complicated radial plans that emerged later [20].

The end of the 18th century witnessed the evolution of the ideas of humanising penalties and recognising the human dignity of the prisoner, which have positively influenced legislation, resulting in new penal thinking in all countries.

The year 1787 witnessed the creation of the logical development of the cellular prisons arranged around a central point, the circular prison, the Panopticon, by Jeremy Bentham (Fig. 5) [25]. The Panopticon reflected new penal philosophy where controlling the mind or soul replaced the punishment of the body [26]. The governor's or the inspector's office was placed in the centre of the building instead of the chapel or the church. He kept all under continuous surveillance and was invisible to all by careful control over geometry and light [21]. The Enlightenment rationality, the political upheavals of the French revolution and the social upheavals of the Industrial Revolution created a reaction of control and discipline. Prison was but the clearest case of the general shift, based on fear, towards rational and rigid order. The enormous 19th century elaboration of theories and practices in prison discipline and management were, in microcosm, theories and practices of social order [22,23,27,28].

The end of the 18th century witnessed the surfacing of the two most powerful, and competing, penal regimes: the *silent* (the Auburn) and the *separate* (the Pennsylvania) systems in America. It was believed that the silent would be an effective way of preventing the spread of moral contagion [27]. The space was used in the separate system as a way to separate and isolate each prisoner so that they did not see or hear the other. Enforcing the principle of individual reform through penitence and labour would rehabilitate the prisoner. They also made important statements about external social relations concerning how the prison is to be seen by society as an instrument of social policy [21]. The penal reforms of the late 18th and early

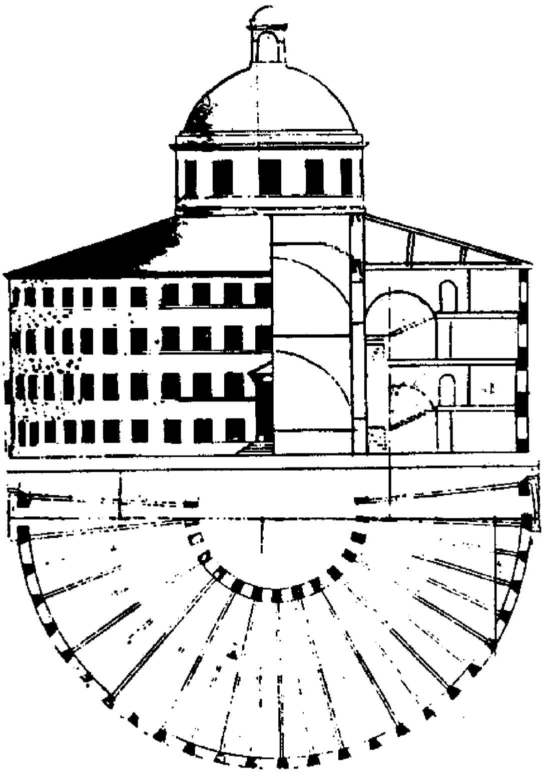


Fig. 5. The Panopticon.

19th centuries not only regularised imprisonment and made it the centrepiece of the penal system but also gave it a moral purpose.

The Auburn system proved its failure by the many death incidents, which occurred because of the lack of exercise areas and leaving the prisoners with no work. The system failed to rise up to its expectations. By the 1850s the ability of the prison to reform was questionable. Reformers introduced a regime whose ambition was to erase the old identity of the offender and to destroy the immoral sociability that was thought to sustain bad habits, but numerous prisoners testified to a different outcome. They felt demeaned and humiliated. The prison system failed to live up to its original ideals but the failure did not have any impact on its longevity. The reform impulse faded without uprooting the prison from the criminal justice system [29]. This typology of prison building was applied worldwide in the period between 1850 and 1950. Most of these prisons are still in use which means that many countries are using prisons that do not reflect the penal ideology in evolution simply because they still exist [30].

A historical review of the development of the prison system showed that imprisonment is a philosophical and social problem before being a building problem. This contradiction is reflected in prison design difficulties. Contemporary architects feel

social responsibilities in providing buildings whose purpose is neither totally accepted nor clearly defined. Prisons today are evaluated as social facilities with a similar importance to other social facilities (hospitals, schools, etc.), and part of the urban infrastructures [30]. Consequently, the contemporary design concepts for prisons should follow the changing ideals in penal institutions' containment philosophy and social structure on the one hand, and the changing ideals of use and design of habitat in general of the architectural style that can express these new aspirations on the other hand.

The two main factors that influence the new trends in prison design internationally are the political and the economical situations of different countries [20].

McConville [31] identified two basic design attitudes in the contemporary prison buildings design: the progressive attitude and the traditional attitude. The former is distinguished by the small size of the institution (500 inmates), where the feeling of domestic life is emphasised as cellblocks are divided into sections for small groups of 12 persons. A variety of different premises are provided in order to give space for different activities. The concept of low density in land use is adopted. Good materials and good architecture are employed in prison design within a comfortable environment with good furniture. Flexibility in the use of the building is one of the main qualities of the progressive attitude in prison building. In contrast, the traditional attitude is still in use. This attitude can be seen in large institutions of around 1000 inmates. The range of activities provided is limited in order to reduce the movement of the prisoners. The building size symbolises the power of the institution. The furniture and the facilities are basic and essential, as the intention is to link discomfort with punishment [31].

New prison design policies emphasise the importance of providing more normalised environments to provide a more supportive setting to the normal behaviour. The importance of providing a healthy indoor environment is recognised in the new prison system. This includes light and view, thermal comfort, noise, interior design, and ventilation [32]. The humane element should be placed at the centre of the process of prison building design in order to ensure that the squalid and haphazard prison conditions of the past do not return.

Recent developments in prison buildings have highlighted the new trends of sustainable architecture. More emphasis is placed on sustainable approaches not only in technical terms, for example reducing energy consumption for maintaining comfort levels, but also relating to social issues. It is interesting to note that such a combination has been stressed in Islamic polices since the seventh century. The following section reviews the Islamic approach to incarceration. It is generally believed that the juridical system in the United Arab Emirates is based on Islamic law. Application and interpretation of such law needs more reinforcement. There are different issues that can be learnt from the tradition of Islamic penal theories. The case study given in Section 4 shows that the intention to use more energy resources to improve inmates' comfort is not accompanied by improving social approaches that together ensure sustainability.

3. Prisons in the Islamic world

Over 750 million Muslims inhabit the earth. Sixty-nine countries have a significant fixed population, which in 37 countries constitutes more than 50% and in 28 countries more than 85% of the population. Seventeen states formally adhere to Islam by so declaring in their constitution [33]. The re-emergence of Muslim and Islamic states in the world community of nations and the adherence of some to Islamic law as a basis of their legal system emphasises the importance of understanding the values and attributes of Islam. Investigating the Islamic penal system is essential in order to verify the special characteristics of the prison institution from the Islamic point of view.

The seventh century AD witnessed the beginning of the Islamic era founded by the prophet Mohammed. Imprisonment can be traced back to the beginning of the Islamic era where it was applied as a penalty to the *Ta'zir* (corrective punishment). *Ta'zir* is one of the three known punishments in Islam, the other two are *Had* (a fixed punishment for certain crimes, the Hudud) and *Qusas* (punishment for crimes of retribution).

As the name indicates, *Ta'zir* punishments were used in order to achieve rehabilitation and reform. Imprisonment is a tool that has been used in the process of rehabilitating the offenders since the middle of the first century in the Islamic world [34]. Literature indicates that offenders were placed in a domestic environment for the period of their confinement in the prophet days as well as the four early caliphs. The prophet Mohammed and his successors the caliphs emphasised the importance of the human treatment of prisoners. Providing the basic needs of the inmate was the responsibility of the state. Some of the Islamic jurists went further by calling for a salary to be paid to the prisoner's family, as while he was confined he would not be able to earn to support them. It is forbidden in Islam to cause any unnecessary pain or humiliation to the offender while executing the punishment [35].

Many of the most forward-looking concepts in today's criminal justice system have been the mainstay of the Islamic approaches for centuries. For example, the ideas of victim compensation, restitution and diversion, work release, periodic imprisonment, conditional release and others were a part of Islamic criminal justice practice. It is noteworthy that the traditional Islamic penal system went beyond most modern penal systems in confronting the sexual problems of prison life. Some demanded that the wives of married prisoners be allowed to visit them occasionally for conjugal privileges [34].

The penal system in an Islamic society takes into account the socio-economic aspects of punishment. Islamic jurists have long recognised the serious consequences of imprisonment. Some argue that it is as serious as *Hudud* penalties and should therefore be nullified in case of doubt. They would restrict its use to dangerous and incorrigible criminals who are held in prison until they show signs of repentance and only then are released [34,35]. Prison buildings should be designed to provide confinement where rehabilitation should be the aim, leading to "repentance" and consequently reunion with society. Design of such buildings should therefore provide adequate indoor comfort. As an Islamic society pays for the inmates' "family allow-

ance", the same society should pay an adequate price for rehabilitation of inmates. This should be the cost of providing an adequate and humane environment for confinement. The question should not therefore be the balance between inmates' comfort and their punishment. The question should addresses the ways to achieve maximum comfort with minimum recourse that will support rehabilitation. It is therefore a question of sustainable architecture in its wider definition.

The following section examines how to tackle the technical part of that question.

4. Prison buildings in Abu Dhabi

In the last 20 years there has been a large increase in energy demand in Abu Dhabi Emirate, the capital of the United Arab Emirates. Electric consumption has increased from 540 GW/h in 1975 to 7000 GW/h in 1997 (Fig. 6) [36]. Research of energy conservation in the built-up environment in the Gulf area shows that such an increase is mainly related to air conditioning and the poor thermal performance of the building envelope [37]. The Ministry of the Interior intends to provide all prisons in Abu Dhabi with air conditioning. A prototype is suggested as a model for all prisons designed in Abu Dhabi. The thermal performance of the envelope of this prototype, however, has not been thoroughly examined. This section examines the impact of such decisions on the total energy requirements for air conditioning. The importance of the building envelope and its contribution to such energy consumption is also explored.

Early prison building design in Abu Dhabi was based on UK standards, which are not suitably adapted to the local conditions. The unexpected rapid changes in the prison population in both the type of crimes and prisoner profiles as well as increased numbers made the living conditions in the existing prisons inhumane. This resulted in a new design policy for prison buildings which reflects the emergence of some fundamental new thinking about the security and control measures.

The new policy represented in the proposed prototype will have a large impact

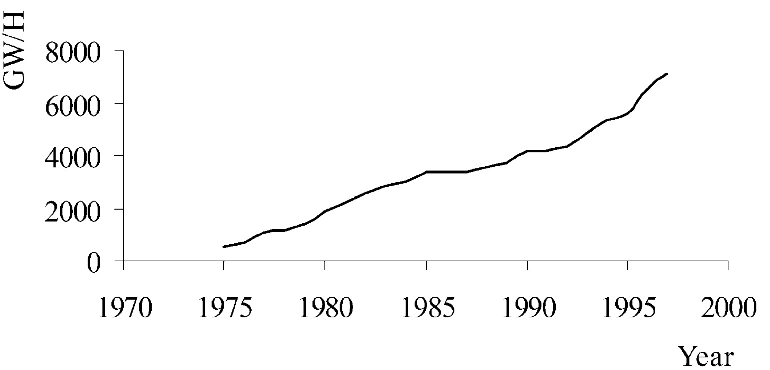


Fig. 6. Abu Dhabi annual electrical consumption.

on the energy consumption in Abu Dhabi through the increase of area per inmate and the introduction of air conditioning. Al-Hosany and Elkadi [38] concluded that an amount of 43.7 GW/h is expected to be consumed if the policy of providing air-conditioning to all prison buildings is implemented. This constitutes 0.6% of the total annual electric consumption in Abu Dhabi. Such an increase in energy consumption will have serious implications not only on the Ministry of the Interior's budget, but also on the total electric production and infrastructure of Abu Dhabi, and will lead to an increase in CO_2 emissions.

There must be a more appropriate prison design for this hostile climate. There is a need to find a balance between the provision of comfortable conditions to achieve rehabilitation in prisons and the cost to society, in this case in energy terms.

4.1. The role of the prison envelope in energy consumption

Al-Hosany and Elkadi [38] proved that the new prison design policy would increase the total annual energy consumption in Abu Dhabi by 0.6%. Fig. 7 shows that the building envelope of the prison building is responsible for 21% of such energy consumption; this could be as much as 0.192% of the total electric consumption in Abu Dhabi (8.4 GW/h). Simulations carried out have illustrated that an efficient skin minimised the peak fabric load by more than 39% (3.27 GW/h of total annual load).

An investigation carried out has proved that orientation plays a major role in shifting the peak hour load through the day. The peak hour in a west located cell is between 2:00 and 5:30 pm while in an east located cell the peak hour is between 7:30 and 12:00 pm. Reducing the load in the east located rooms, therefore, can be achieved economically by using passive methods such as night cooling, whilst in

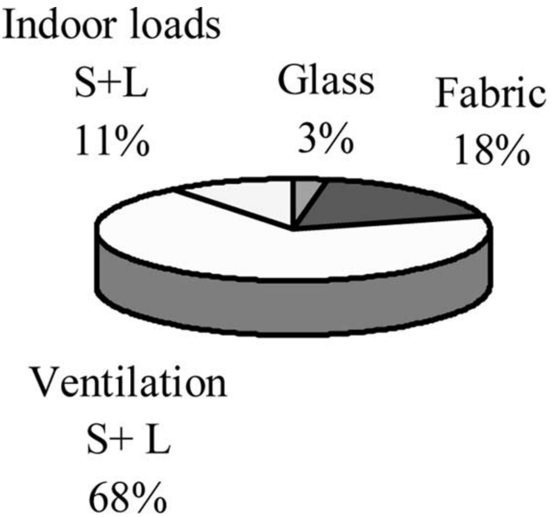


Fig. 7. Envelope role in electric consumption in prison building.

the rooms situated in the west, air conditioning is the main technique that can be used to reduce the peak load to achieve comfortable levels during the hot evening hours. Other devices such as using appropriate glazing materials and/or shading devices might help to reduce the thermal load. The data for peak hours, however, show no relation between the sharp increase in peak load and the time of direct sunshine on western facades.

It has been proven that reducing the persons per square metre rate leads to an increase in the cooling load per square metre [39]. Appropriate design of prisons will ensure an efficient profile for occupancy and activities. The location of different activities can have a large impact on the peak load energy consumption profile. It is therefore important to integrate an energy efficiency strategy in the early stages of prison design.

Simulation of the prepared prison prototype shows that large energy savings can be achieved when orientation and configuration of the prison facades are investigated. This is a necessary step on the road to achieving sustainable architecture. This step, however, is not enough. The previous discussion and literature review showed that the success of sustainability depends on achieving social and economic goals as well as technical goals. Rehabilitation approaches and contemporary penal theories should also be considered in sustainable incarceration architecture. The paper shows that adequate and comfortable provision of ventilation, for example, can help in achieving both technical and ethical objectives in sustainable incarceration architecture. Mobility of inmates as recommended in social theories can also, if properly considered, lead to energy conservation. In fact, it is suggested that the conflict between incarceration architecture and sustainable architecture can be resolved.

5. Conclusion

This review of the historical development of penal systems has shown that the design of prison buildings has moved from being a tool for physical restraint of inmates into introducing human values in order to achieve rehabilitation. Most recently, the concept of imprisonment is questioned and current rehabilitation approaches are subject to serious criticism. Some basic contemporary principles and rules of social approaches towards incarceration can be traced to the traditional Islamic law. In the United Arab Emirates the current system of imprisonment is, however, to continue for the foreseeable future. It is argued that the sustainable features of natural and human values on the one hand and technical issues on the other hand are inseparable in this type of building. Recent efforts in the United Arab Emirates to increase comfort, and hence improve rehabilitation programmes, within prison buildings will lead to extensive use of resources and energy consumption. The technical "fix" of introducing an appropriate façade configuration, for example, can help to achieve energy efficiency. However, the technical factors that affect the thermal performance cannot improve the sustainability of such a controversial building typology. In prison building, a typology driven by cultural values and social theories, socio-economic factors have a great impact on the sustainable design of

prison façades. This paper, therefore, emphasises the importance of social aspects in conjunction with technical energy saving measures to achieve real sustainable architecture.

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